


# WATER SUPPLY OUTLOOK
and
FEDERAL - STATE - PRIVATE COOPERATIVE SNOW SURVEYS
**for**

# WESTERN UNITED STATES
## Including Columbia River Drainage in Canada

UNITED STATES DEPARTMENT of AGRICULTURE···SOIL CONSERVATION SERVICE
Collaborating with
CALIFORNIA DEPARTMENT of WATER RESOURCES
and
BRITISH COLUMBIA DEPARTMENT of
LANDS, FORESTS and WATER RESOURCES

AS OF
**APR. 1, 1966**

# UNITED STATES DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

*To Recipients of Water Supply Outlook Reports:*

Most of the usable water in western states originates as mountain snowfall. This snowfall accumulates during the winter and spring, several months before the snow melts and appears as streamflow. Since the runoff from precipitation as snow is delayed, estimates of snowmelt runoff can be made well in advance of its occurrence. Streamflow forecasts published in this report are based principally on measurement of the water equivalent of the mountain snowpack.

Forecasts become more accurate as more of the data affecting runoff are measured. All forecasts assume that climatic factors during the remainder of the snow accumulation and melt season as they affect runoff will add to be an effective average. Early season forecasts are therefore subject to a greater change than those made on later dates.

The snow course measurement is obtained by sampling snow depth and water equivalent at surveyed and marked locations in mountain areas. A total of about ten samples are taken at each location. The average of these are reported as snow depth and water equivalent. These measurements are repeated in the same location near the same dates each year.

Snow surveys are made monthly or semi-monthly from January 1 through June 1 in most states. There are about 1400 snow courses in Western United States and in the Columbia Basin in British Columbia. In the near future, it is anticipated that automatic snow water equivalent sensing devices along with radio telemetry will provide a continuous record of snow water equivalent at key locations.

Detailed data on snow course and soil moisture measurements are presented in state and local reports. Other data or reservoir storage, summaries of precipitation, current streamflow, and soil moisture conditions at valley elevations are also included. The report for Western United States presents a broad picture of water supply outlook conditions, including selected streamflow forecasts, summary of snow accumulation to date, and storage in larger reservoirs.

Snow survey and soil moisture data for the period of record are published by the Soil Conservation Service by states about every five years. Data for the current year is summarized in a West-wide basic data summary and published about October 1 of each year.

Listed below are water supply outlook reports based on Federal-State-Private Cooperative snow surveys. Those published by the Soil Conservation Service may be obtained from Soil Conservation Service, Room 507, Federal Building, 701 N. W. Glisan, Portland, Oregon 97209.

## PUBLISHED BY SOIL CONSERVATION SERVICE

| REPORTS | ISSUED | LOCATION | COOPERATING WITH |
|---|---|---|---|
| **RIVER BASINS** | | | |
| WESTERN UNITED STATES | MONTHLY (FEB.-MAY) | PORTLAND, OREGON | ALL COOPERATORS |
| BASIC DATA SUMMARY | OCTOBER 1 | PORTLAND, OREGON | ALL COOPERATORS |
| **STATES** | | | |
| ALASKA | MONTHLY (MAR.-MAY) | PALMER, ALASKA | ALASKA S.C.D. |
| ARIZONA | SEMI-MONTHLY (JAN.15 - APR.1) | PHOENIX, ARIZONA | SALT R. VALLEY WATER USERS ASSOC.<br>ARIZ. AGR. EXP. STATION |
| COLORADO AND NEW MEXICO | MONTHLY (FEB.-MAY) | FORT COLLINS, COLORADO | COLO. STATE UNIVERSITY<br>COLO. STATE ENGINEER<br>N. MEX. STATE ENGINEER |
| IDAHO | MONTHLY (JAN.-JUNE) | BOISE, IDAHO | IDAHO STATE RECLAMATION ENGINEER |
| MONTANA | MONTHLY (JAN.-JUNE) | BOZEMAN, MONTANA | MONT. AGR. EXP. STATION |
| NEVADA | MONTHLY (JAN.-MAY) | RENO, NEVADA | NEVADA DEPT. OF CONSERVATION AND NATURAL RESOURCES - DIVISION OF WATER RESOURCES |
| OREGON | MONTHLY (JAN.-JUNE) | PORTLAND, OREGON | OREG. STATE UNIVERSITY<br>OREGON STATE ENGINEER |
| UTAH | MONTHLY (JAN.-JUNE) | SALT LAKE CITY, UTAH | UTAH STATE ENGINEER |
| WASHINGTON | MONTHLY (FEB.-JUNE) | SPOKANE, WASHINGTON | WN. STATE DEPT. OF CONSERVATION |
| WYOMING | MONTHLY (FEB.-JUNE) | CASPER, WYOMING | WYOMING STATE ENGINEER |

## PUBLISHED BY OTHER AGENCIES

| REPORTS | ISSUED | AGENCY |
|---|---|---|
| BRITISH COLUMBIA | MONTHLY (FEB.-JUNE) | WATER RESOURCES SERVICE, DEPT. OF LANDS, FOREST AND WATER RESOURCES, PARLIAMENT BLDG., VICTORIA, B.C., CANADA |
| CALIFORNIA | MONTHLY (FEB.-MAY) | CALIF. DEPT. OF WATER RESOURCES, P.O. BOX 388, SACRAMENTO, CALIF. |

USDA-SCS-PORTLAND, OREG. 1965

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ISSUED

APRIL 1, 1966

The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Corps of Engineers, Forest Service, National Park Service, Geological Survey, and other Federal Agencies, Departments of State Government, Irrigation Districts, Power Companies, and others.

The Department of Water Resources coordinates snow surveys in California.

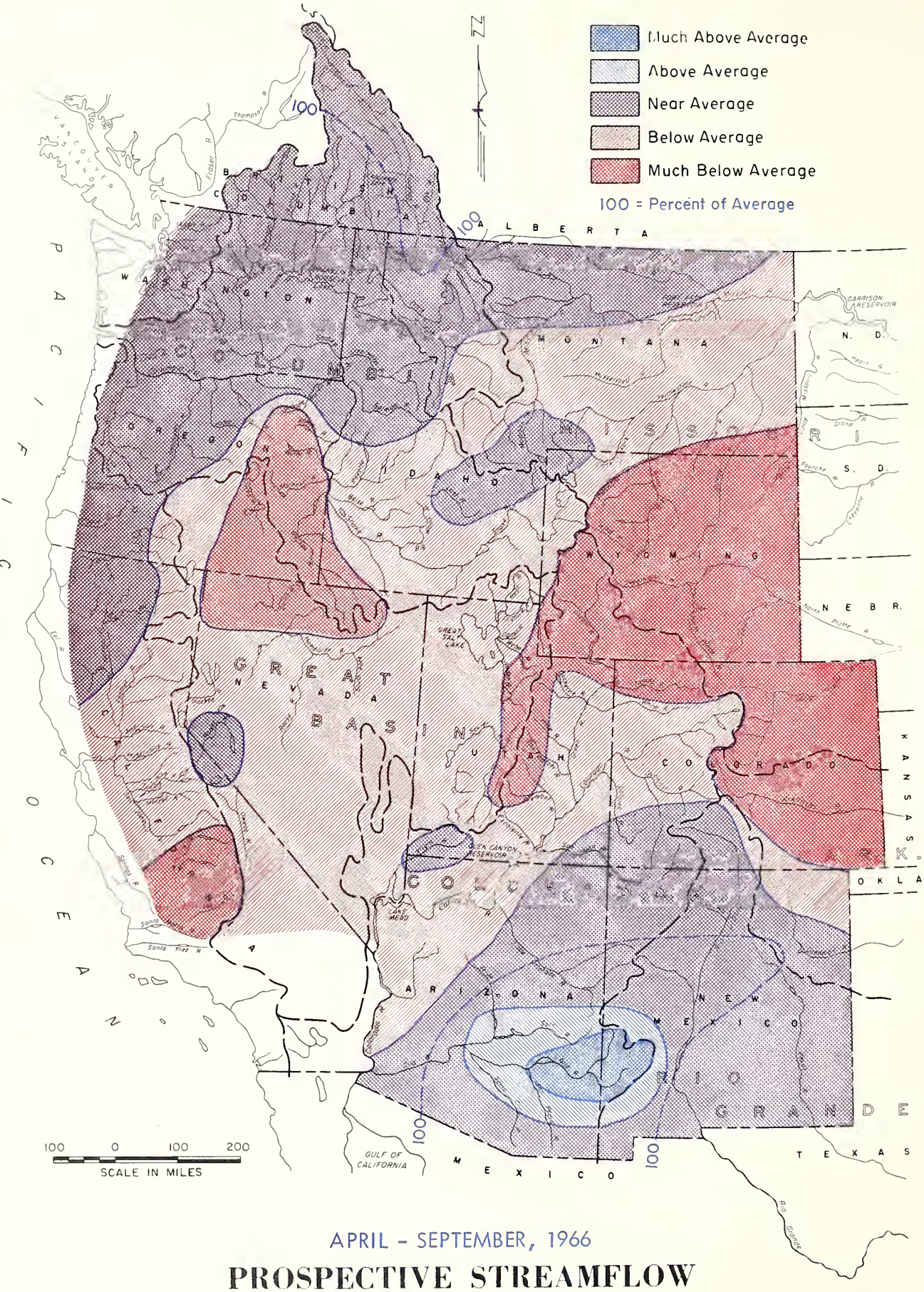
The Water Resources Service, Department of Lands, Forests, and Water Resources directs snow surveys in British Columbia.

This report was prepared by the Water Supply Forecasting Branch, Engineering Division, Soil Conservation Service, from data supplied by Snow Survey Supervisors of the Soil Conservation Service in the States of Arizona, Colorado and New Mexico, Idaho, Montana, Nevada, Oregon, Utah, Washington and Wyoming.

Data from California was supplied by the Chief, Water Supply Forecast and Snow Surveys Unit, Department of Water Resources.

Data from British Columbia was supplied by the Chief, Hydrology Division, Water Investigations Branch, Department of Lands, Forests and Water Resources.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
D. A. WILLIAMS, ADMINISTRATOR




APRIL - SEPTEMBER, 1966

# PROSPECTIVE STREAMFLOW

AS OF APRIL 1, 1966

# WATER SUPPLY OUTLOOK

## As of April 1, 1966

FORECASTS OF SNOWMELT DROPPED SHARPLY DURING MARCH. NEAR MINIMUM RECORD FLOWS EXPECTED OVER MUCH OF COLORADO, WYOMING AND UTAH. WATER SUPPLY PROSPECTS REMAIN SATISFACTORY FOR MAJOR IRRIGATION AREAS SERVED BY ABOVE AVERAGE RESERVOIR STORAGE.

Carryover storage from the high-runoff year of 1965 will make the difference between adequate water supplies for 1966 and widespread shortage for irrigation except for the extreme northwest, central Arizona and the Rio Grande. Weather patterns during March varied widely from normal on the side of low precipitation and high temperatures. From northern Wyoming to the Rio Grande headwaters in Colorado and to southern Utah, snow water content even at high elevations decreased rather than increased for the month. As a result streamflow forecasts have been reduced in the range of 20 percent of average and up to 50 percent on a few streams. While this lack of snowfall was most notable in these states, the pattern extended to a lesser degree to northern Montana, to central Idaho and to the Sierras of California. Since streamflow prospects were poorest in Colorado, Wyoming and Utah relative to other western areas a month ago, streamflow shortage is most severe in these same areas as of April 1.

WEATHER IN THE 10 DAY PERIOD BETWEEN THE AVERAGE DATE OF SNOW COURSE MEASUREMENTS AND THE PREPARATION OF THIS REPORT HAS CONTINUED WARM AND DRY. THIS INDICATES THAT STREAMFLOW FORECASTS WILL CONTINUE TO DECLINE BECAUSE OF LACK OF SNOWFALL IN THIS CRITICAL PERIOD.

However, the larger irrigated areas here as well as other states have reasonably adequate water supplies in prospect because of high carryover storage. Water users who do not have access to storage will have severe shortages. Except for central Arizona and western Oregon and Washington, there will be a substantial depletion of stored water supplies to meet demands of the 1966 season.

The California Department of Water Resources reports continued decline in streamflow forecasts for most of the streams in the state as the result of the third consecutive month of below normal precipitation. In the Central Valley only the upper Sacramento River Basin is forecasted for normal runoff while the runoff for the remaining tributaries is forecasted to be about 30 percent below normal assuming normal precipitation for the remainder of the season. The snowpack of the Sierra tributaries to the Central Valley is about 80 percent of the April 1 average with the greater amounts observed on the northern watersheds.

### SNOWPACK

Snow accumulation to April 1 has been below average on most mountain watersheds, typically 60 to 80 percent of average. Near or above average snowfall has been measured on the Columbia River watershed in British Columbia, on and near the Cascade range in Washington and Oregon, and in northern California. Above average snowpack remains on the Gila watershed in Arizona. The greatest deficiencies in seasonal snow accumulation have occurred on east slope streams in Colorado and Wyoming, the source areas of the Green and Colorado rivers, and the southern one-third of the Sierra range in California. Relative low snowpacks also exist throughout the interior basin in Nevada, Utah and southeastern Oregon.

### STORAGE

Storage in irrigation, municipal and multipurpose reservoirs is well above average in all states except in Washington which represents a substantial improvement over a year ago. Carryover storage is especially high in respect to average in the states of Arizona, Colorado, Idaho and Nevada. On the Missouri River main stem, storage in the large reservoirs is well above average. While storage in Lake Mead is below average for this date, the total storage on the Colorado and its principal tributaries increased substantially over April 1965 as a result of high runoff during the past year. If all storage were in Lake Mead, the contents would be near capacity. Inflow prospects for this year are poor, about 40 percent of annual flow in 1965. With deficient winter flows on the Columbia River power reservoirs have been lowered to meet generation requirements.

### STREAMFLOW FORECASTS

There has been a general decline in streamflow forecasts for the past two months. The reduction in expected streamflow was especially large during March except for the Columbia Basin and coastal areas of Oregon, Washington and northern California. Most streamflow forecasts are now in the range of 60 to 80 percent of average. Near average streamflow is expected for the upper Columbia and its tributaries above Grand Coulee, streams in western Oregon and Washington, and extreme northern California. Lowest forecasts are for streams east of the Continental Divide in Wyoming and Colorado and in north

## SUMMARY OF SNOW WATER EQUIVALENT MEASUREMENTS APRIL 1, 1966

| MAJOR BASIN AND SUB—WATERSHED | WATER EQUIVALENT IN PERCENT OF: LAST YEAR | AVERAGE |
|---|---|---|
| MISSOURI BASIN | | |
| Jefferson | 45 | 63 |
| Madison | 55 | 73 |
| Gallatin | 55 | 75 |
| Missouri Main Stem | 54 | 70 |
| Yellowstone | 55 | 73 |
| Shoshone | 57 | 57 |
| Wind | 54 | 69 |
| North Platte | 55 | 62 |
| South Platte | 46 | 54 |
| ARKANSAS BASIN | | |
| Arkansas | 42 | 58 |
| Canadian | 51 | 76 |
| RIO GRANDE BASIN | | |
| Rio Grande (Colo.) | 52 | 75 |
| Rio Grande abv. Otowi Bridge | 55 | 79 |
| Pecos | 50 | 128 |
| COLORADO BASIN | | |
| Green (Wyo.) | 43 | 63 |
| Yampa - White | 50 | 62 |
| Duchesne | 89 | 84 |
| Price | 65 | 79 |
| Upper Colorado | 50 | 64 |
| Gunnison | 54 | 66 |
| San Juan | 65 | 86 |
| Dolores | 60 | 79 |
| Virgin | 90 | 82 |
| Gila | 97 | 132 |
| Salt | 65 | 74 |
| GREAT BASIN | | |
| Bear | 61 | 69 |
| Logan | 55 | 73 |
| Ogden | 78 | 77 |
| Weber | 57 | 67 |
| Provo - Utah Lake | 61 | 64 |
| Jordan | 55 | 63 |
| Sevier | 71 | 66 |
| Walker - Carson | 68 | 85 |
| Tahoe - Truckee | 61 | 74 |
| Humboldt | 72 | 57 |
| Lake Co. (Oregon) | 125 | 86 |
| Harney Basin (Oregon) | 52 | 57 |
| UPPER COLUMBIA BASIN | | |
| Columbia (Canada) | 103 | 95 |
| Kootenai | 87 | 93 |
| Clark Fork | 56 | 77 |
| Bitterroot | 60 | 71 |
| Flathead | 72 | 87 |
| Spokane | 84 | 88 |
| Okanogan | 94 | 91 |
| Methow | 101 | 82 |
| Chelan | 88 | 95 |
| Wenatchee | 87 | 86 |

| MAJOR BASIN AND SUB—WATERSHED | WATER EQUIVALENT IN PERCENT OF: LAST YEAR | AVERAGE |
|---|---|---|
| SNAKE BASIN | | |
| Snake above Jackson, Wyo. | 65 | 77 |
| Snake above Hiese, Idaho | 59 | 74 |
| Snake abv. American Falls Res. | 59 | 76 |
| Henry's Fork | 57 | 73 |
| Southern Idaho Tributaries | 59 | 73 |
| Big and Little Wood | 46 | 74 |
| Boise | 54 | 73 |
| Owyhee | 60 | 63 |
| Payette | 61 | 76 |
| Malheur | 51 | 65 |
| Weiser | 70 | 88 |
| Burnt | 69 | 81 |
| Powder | 64 | 76 |
| Salmon | 51 | 71 |
| Grande Ronde | 61 | 78 |
| Clearwater | 78 | 91 |
| LOWER COLUMBIA BASIN | | |
| Yakima | 105 | 96 |
| Umatilla | 90 | 92 |
| John Day | 64 | 76 |
| Deschutes - Crooked | 111 | 95 |
| Hood | 133 | 114 |
| Willamette | 146 | 116 |
| Lewis | 143 | 122 |
| Cowlitz | 106 | 103 |
| PACIFIC COASTAL BASIN | | |
| Puget Sound | 106 | 96 |
| Olympic Peninsula | 155 | 110 |
| Umpqua - Rogue | 147 | 112 |
| Klamath | 115 | 98 |
| Trinity | 210 | 130 |
| CALIFORNIA CENTRAL VALLEY | | |
| Upper Sacramento | 170 | 120 |
| Feather | 105 | 95 |
| Yuba | 90 | 95 |
| American | 75 | 85 |
| Mokelumne | 75 | 75 |
| Stanislaus | 70 | 70 |
| Tuolumne | 65 | 70 |
| Merced | 70 | 75 |
| San Joaquin | 75 | 75 |
| Kings | 80 | 80 |
| Kaweah | 65 | 65 |
| Tule | 70 | 40 |
| Kern | 75 | 65 |

*Data for California Watersheds supplied by Dept. of Water Resources, and for British Columbia Watersheds by Dept. of Lands, Forests and Water Resources.*

*Average is for 1948-62 period.* California averages are for the period 1931-1960. *Based on Selected Snow Courses determined by Distribution within the Basin, Length of Record and Repetitive Monthly Measurement Schedules.*

central Utah where forecasts are about one-half of average and near a minimum of record.

Winter flow has been above average in areas outside of the Columbia Basin and the Central Valley of California.

## MISSOURI BASIN

Snow accumulation to date is 65 to 75 percent of average on upper Missouri tributaries except for those in northern Montana where it is slightly higher. Melt began in late March and is continuing at higher elevations. Low elevation snow has disappeared. Forecasts for summer flow range from 90 percent of average on the upper Madison and Red Rock drainages down to 75 percent on the lower reaches of the Missouri tributaries above Three Forks. All streamflow will be much less than in 1964 and 1965. Late season shortages will occur along all smaller streams without reservoir storage including some of the major tributaries to the Missouri.

The upper Yellowstone is forecast to flow about 75 percent of average. Near minimum of record flows are expected from the Bighorn drainage from Wyoming. With limited inflow expected from tributary streams through the plains area, forecasts drop to about 65 percent of average as the Yellowstone and Missouri come together in western North Dakota.

Fair streamflow prospects in the Bighorn Basin of Wyoming declined to poor during March. Snowmelt season flows of 40 to 60 percent of average are now in prospect for the Bighorn and its tributaries. The water shortage extends to the Powder and Tongue Rivers east of the Bighorn Mountains. Irrigation water supplies will be restricted in this basin along the smaller streams. Storage will provide an adequate supplement for irrigation directly from the Shoshone and the Bighorn below Boysen Dam.

For the North Platte, inflow to Seminoe Reservoir is not expected to exceed one-half of average this year which will restrict late season use in the high valleys. Below the North Platte reservoir system water supply will be adequate for the major irrigated areas of eastern Wyoming and western Nebraska because of the above average storage situation left over from 1965.

South Platte tributaries in Colorado have a near minimum mountain snowpack on their watersheds. Snowfall during March was almost nonexistent. Many snow courses, even at high elevations, lost water during the month. Streamflow forecasts are in the range of that which occurred in the drouth year of 1954. To alleviate this shortage of streamflow, storage in irrigation reservoirs is well above average and a substantial supplemental water supply is available from the Colorado-Big Thompson reservoir and diversion system. However, if summer demands are high and streamflow prospects further decline, some shortage could occur.

Storage in Denver Municipal reservoirs is especially favorable with recent increases in capacity.

## ARKANSAS BASIN

Natural streamflow of the main Arkansas as it leaves the mountains is not expected to exceed one-half of average in 1965. Storage in mountain and plains reservoirs exceeds average, and John Martin is at conservation capacity. Although there have been many years with less water in sight on this stream, water supply will not be plentiful this year. Careful planning will be required and shortage may occur if summer demands are high. Less than average flows are in prospect for the southern tributaries to the Arkansas.

Snowmelt season flow in the upper Canadian in northeastern New Mexico will be much less than average. Storage in Conchas Reservoir should provide an adequate water supply for the Tucumcari project.

## RIO GRANDE BASIN

Storage and streamflow are expected to provide an average water supply for the Rio Grande and its tributaries for the major irrigated areas of San Luis Valley. There will be some deficiency in flow in streams from the Sangre de Cristo range. March snowfall on this drainage was also deficient bringing streamflow forecasts down to slightly below average.

Rio Grande inflow to the Middle Rio Grande District of New Mexico is expected to be just above average in 1966 and about three-quarters of the flow for 1965. Storage in Elephant Butte for the lower Rio Grande area of southern New Mexico and west Texas is above average but only one-quarter of capacity. While water supply is not plentiful, this will be one of the better water supply years of recent times.

On the Pecos the outlook is for satisfactory snowmelt season flow but storage in Alamogordo is down below average.

## COLORADO BASIN

Lack of snowfall during March along with losses from earlier season snow decreased streamflow prospects radically over the entire upper Colorado River Basin. Snow accumulation is now 60 to 70 percent of average for the date. Because of relatively higher demands for consumptive use of water in the upper basin the forecast of inflow to Lake Powell is only 55 percent of average, roughly 40 percent of that which occurred in 1965.

## SELECTED STREAMFLOW FORECASTS APRIL-SEPTEMBER 1966 as of APRIL 1, 1966

| STREAM AND STATION | 1000 ACRE-FEET | | PERCENT OF AVERAGE |
|---|---|---|---|
| | FLOW | FORECAST | |
| UPPER MISSOURI | 1965 | 1966 | 1966 |
| Jefferson at Sappington, Montana | 1729 | 745 | 76 |
| Madison near Grayling, Montana 1/ | 577 | 380 | 91 |
| Gallatin near Gateway, Montana | 649 | 358 | 80 |
| Missouri near Zortman, Montana 2/ | | 3400 | 75 |
| Sun at Gibson Dam, Montana 3/ | 702 | 532 | 87 |
| Marias near Shelby, Montana 4/ | 751 | 524 | 81 |
| Milk near Eastern Crossing, Montana | 332 | 216 | 86 |
| Yellowstone at Livingston, Montana | 2942 | 1740 | 82 |
| Shields at Clyde Park, Montana | 162 | 84 | 85 |
| Clark Fork at Chance, Montana | 763 | 500 | 86 |
| Shoshone, Inflow to Buffalo Bill Res., Wyo. | | 520 | 64 |
| Wind at Dubois, Wyoming | | 48 | 48 |
| Bull Lake near Lenore, Wyoming | | 128 | 72 |
| Tensleep near Tensleep, Wyoming | | 32 | 44 |
| Yellowstone at Miles City, Montana 5/ | 9053 | 3700 | 64 |
| Missouri near Williston, N. Dakota 6/ | | 7100 | 64 |
| PLATTE | | | |
| North Platte at Saratoga, Wyoming | | 305 | 48 |
| Laramie near Jelm, Wyoming 7/ | | 56 | 50 |
| Clear at Golden, Colorado | 200c | 77 | 57 |
| St. Vrain at Lyons, Colorado | 110 | 37 | 46 |
| Cache LaPoudre near Fort Collins, Colorado 8/ | 275c | 120 | 49 |
| ARKANSAS | | | |
| Arkansas at Salida, Colorado 9/ | 571c | 160 | 46 |
| Purgatoire at Trinidad, Colorado | 52 | 30 | 67 |
| RIO GRANDE | | | |
| Rio Grande near Del Norte, Colorado 10/ | 826c | 455 | 92 |
| Conejos near Mogote, Colorado 11/ | 279c | 180 | 92 |
| Rio Chama near LaPuente, New Mexico | 216 | 180 | 94 |
| Rio Grande at Otowi Bridge, New Mexico 12/ | 890c | 640 | 105 |
| Pecos at Pecos, New Mexico * | 80 | 60 | 113 |
| UPPER COLORADO | | | |
| Colorado near Granby, Colorado 13/ | | 142 | 61 |
| Colorado near Glenwood Springs, Colorado 14/ | 1351c | 1000 | 64 |
| Roaring Fork at Glenwood Springs, Colorado 15/ | 1027c | 560 | 73 |
| Gunnison at Grand Junction, Colorado | 2282c | 900 | 69 |
| Dolores at Dolores, Colorado | 381 | 220 | 85 |
| Colorado near Cisco, Utah | 5442 | 2500 | 66 |
| Green below Flaming Gorge Res., Utah 16/ | 1251 | 620 | 55 |
| Yampa at Steamboat Springs, Colorado | 346 | 170 | 58 |
| White at Meeker, Colorado | 387 | 210 | 63 |
| Duchesne near Tabiona, Utah 17/ | | 72 | 63 |
| Rock Creek near Mountain Home, Utah | | 77 | 75 |
| Price near Scofield, Utah 18/ | | 23 | 62 |
| Green at Green River, Utah 16/ | | 1650 | 49 |
| San Juan near Rosa, New Mexico | 1064 | 600 | 101 |
| Animas at Durango, Colorado | 718 | 420 | 92 |
| San Juan near Bluff, Utah 19/ | 2090 | 1070 | 91 |
| Colorado, Inflow to Lake Powell, Arizona 20/ | 11810 | 4200 | 55 |
| LOWER COLORADO | | | |
| Gila near Solomon, Arizona | 39 | 57 | 146 |
| Salt at Intake, Arizona | 292 | 180 | 125 |
| Verde above Horseshoe Dam, Arizona | 274 | 31 | 65 |

(c) Subject to correction for diversions and storage.

## SELECTED STREAMFLOW FORECASTS APRIL-SEPTEMBER 1966 as of APRIL 1, 1966

| STREAM AND STATION | 1000 ACRE-FEET | | PERCENT OF AVERAGE |
|---|---|---|---|
| | FLOW | FORECAST | |
| GREAT BASIN | 1965 | 1966 | 1966 |
| Bear at Harer, Idaho | 511 | 157 | 61 |
| Logan near Logan, Utah 21/ | 183 | 89 | 67 |
| Ogden, Inflow to Pine View Res., Utah 22/ | 161 | 88 | 77 |
| Weber near Oakley, Utah | 188 | 94 | 76 |
| Inflow to Utah Lake, Utah | 381 | 180 | 64 |
| Big Cottonwood near Salt Lake City, Utah | 48 | 30 | 77 |
| Beaver near Beaver, Utah | 16 | 17 | 70 |
| South Fork Humboldt near Elko, Nevada | 93 | 50 | 83 |
| Humboldt at Palisades, Nevada | 247 | 120 | 70 |
| Truckee at Farad, California 25/ | 320 | 202 | 75 |
| East Carson near Gardnerville, Nevada | 235 | 155 | 87 |
| West Walker near Coleville, California | 186 | 125 | 89 |
| UPPER COLUMBIA | | | |
| Columbia at Revelstoke, British Columbia | 19409 | 21400 | 107 |
| Kootenai at Wardner, British Columbia | 4700 | 4800 | 100 |
| Kootenai at Leonia, Idaho | 9131 | 9500 | 102 |
| Flathead near Columbia Falls, Montana 26/ | 7472 | 5830 | 90 |
| Flathead near Polson, Montana 26/ | 9216 | 6900 | 89 |
| Clark Fork above Missoula, Montana | 2517 | 1340 | 73 |
| Bitterroot near Darby, Montana | 740 | 425 | 93 |
| Clark Fork at Whitehorse Rapids, Montana 26/ | 17390 | 12130 | 84 |
| Columbia at Birchbank, British Columbia 26/ | 43110 | 46000 | 102 |
| Spokane at Post Falls, Idaho 27/ | 3345 | 2800 | 82 |
| Columbia at Grand Coulee, Washington 26/ | 69660 | 69500 | 99 |
| Okanogan near Tonasket, Washington | 1637 | 1730 | 88 |
| Chelan at Chelan, Washington 28/ | | 1060 | 78 |
| Wenatchee at Peshastin, Washington | 1751 | 1630 | 85 |
| SNAKE | | | |
| Snake above Palisades Res., Wyoming 29/ | | 2060 | 79 |
| Snake near Heise, Idaho 29/ | 5260 | 3000 | 78 |
| Henry's Fork near Rexburg, Idaho 30/ | 1584 | 1080 | 86 |
| Big Lost near Mackay, Idaho 31/ | 341 | 160 | 105 |
| Big Wood, Inflow to Magic Res., Idaho 32/ | 662 | 190 | 69 |
| Bruneau near Hot Springs, Idaho | 279 | 160 | 75 |
| Owyhee Res., Net Inflow, Oregon | 411 | 160 | 42 |
| Boise near Boise, Idaho 33/ | 2783 | 1250 | 77 |
| Malheur near Drewsey, Oregon | 119 | 35 | 43 |
| Payette near Horseshoe Bend, Idaho 34/ | 2810 | 1600 | 80 |
| Snake at Weiser, Idaho | 9048 | 5100 | 73 |
| Salmon at Whitebird, Idaho | 10254 | 5800 | 83 |
| Clearwater at Spalding, Idaho | 10160 | 7800 | 85 |
| LOWER COLUMBIA | | | |
| Grande Ronde at LaGrande, Oregon | | 120 | 59 |
| Yakima at Cle Elum, Washington 35/ | | 850 | 81 |
| Deschutes at Benham Falls, Oregon 36/ | | 555 | 88 |
| Columbia at The Dalles, Oregon 26/ | 112902 | 101200 | 93 |
| Hood near Hood River, Oregon 36/ | | 375 | 98 |
| Willamette at Salem, Oregon 36/ | | 5635 | 101 |
| Lewis at Ariel, Washington 37/ | | 1620 | 112 |
| Cowlitz at Castle Rock, Washington | | 2900 | 98 |

*Forecasts in California provided by Department of Water Resources.*
*Average is for 1948-62 period except California. California is computed for 1911-1960.*
*Forecasts assume average Effective Climatic Conditions from Date Through Snow Melt Season.*

*Explanatory Notes on Forecasts Listed on Inside Back Cover.*
** April - June Period ** April - July Period*

## SELECTED STREAMFLOW FORECASTS APRIL-SEPTEMBER 1966 as of APRIL 1, 1966

| STREAM AND STATION | 1000 ACRE-FEET | | PERCENT OF AVERAGE |
|---|---|---|---|
| | FLOW | FORECAST | |
| | 1965 | 1966 | |
| NORTH PACIFIC COASTAL | | | |
| Dungeness near Sequim, Washington | | 170 | 96 |
| Rogue at Raygold, Oregon | | 1020 | 80 |
| Klamath Lake, Net Inflow, Oregon | | 510 | 80 |
| CALIFORNIA CENTRAL VALLEY 38/** | | | |
| Sacramento, Inflow to Shasta, California | 2030 | 1700 | 95 |
| Feather near Oroville, California | 2262 | 1320 | 68 |
| Yuba at Smartville, California | 1287 | 790 | 70 |
| American, Inflow to Folsom Res., Calif. | 1519 | 880 | 63 |
| Cosumnes at Michigan Bar, California | 174 | 65 | 50 |
| Mokelumne, Inflow to Pardee Res., Calif. | 581 | 295 | 61 |
| Stanislaus, Inflow to Melones Res., Calif. | 880 | 425 | 58 |
| Tuolumne, Inflow to Don Pedro Res., Calif. | 1493 | 760 | 63 |
| Merced, Inflow to Excheque Res., Calif. | 745 | 380 | 61 |
| San Joaquin, Inflow to Millerton Lake, Calif. | 1421 | 760 | 63 |
| Kings, Inflow to Pine Flat Res., California | 1300 | 780 | 66 |
| Kaweah, Inflow to Terminus Res., California | 314 | 150 | 57 |
| Tule, Inflow to Success Res., California | 64 | 25 | 45 |
| Kern, Inflow to Isabella Res., California | 456 | 240 | 55 |

*Forecasts in California provided by Department of Water Resources.*
*Average is for 1948-62 period except California. California is computed for 1911-1960*
*Forecasts assume average Effective Climate Conditions from Date Through Snow Melt Season.*

*Explanatory Notes on Forecasts listed on Inside Back Cover.*
** April - June Period ** April - July Period*

Forecasts of major tributary streams are for about 60 percent of average flow except for the San Juan and Dolores where near average flows are in prospect. Late season shortages are likely to occur on smaller tributaries of the Colorado and may extend to all streams except for direct diversions from the Colorado, Gunnison, White and tributaries to the San Juan. For the larger irrigated areas water supplies will be adequate.

Very little water will be available to the Green and Colorado rivers from the tributaries in Utah. Local forecasts are for below average flow and water which will be used or stored. Carryover storage in larger reservoirs is relatively high. Adequacy of water supply depends directly on storage rights.

For the lower basin, water supply outlook for the Central Valley of Arizona is the most favorable of any of the past 25 years. Carryover storage from last year was relatively high. Winter rainfall and recent snowmelt filled the Salt River Project reservoirs to capacity. San Carlos Reservoir contains 41 percent of capacity, the highest since 1943. Continued high snowmelt runoff is expected through April and May.

## INTERIOR BASIN

Water supply conditions are so variable among streams of the Interior Basin in Utah that a check needs to be made on individual streams. Midwinter snowfall was generally near average, but February snowfall was light and March weather resulted in net losses to mountain snowpack rather than the usual increases. In general, irrigated lands below the larger reservoirs will have adequate water. Those lands without storage rights are due for water shortage. Near average streamflow is still in prospect for the southwest section of the state. Lowest streamflow forecasts in the range of 30 to 50 percent of average are for the upper Bear River and streams from low elevation watersheds east of Salt Lake. A heavy draft on available storage will be required in all areas.

Throughout Nevada water supplies along the Humboldt will be generally satisfactory, especially below Rye Patch Reservoir which is full. There will be shortage of water on streams north of the main Humboldt River. In western Nevada stream forecasts are in the range of three-quarters of average. Here also, because carryover storage is high, water sup-

plies for irrigated areas from east slope of Sierra streams will be satisfactory.

The Harney Basin in Oregon will have a very limited irrigated water supply.

## COLUMBIA BASIN

The Water Resources Service of the Province of British Columbia reports that, based primarily on April 1 snow surveys, streamflow forecasts indicate that spring and summer volume runoff is expected to be slightly above average for the Upper Columbia and moderately above average for the lower mainland and Vancouver Island watersheds. Below average runoff is anticipated for the Okanogan and Similkameen drainages. Close to average runoff is forecast for the Kootenay, Lower Columbia and Frazer watersheds.

The Clark Fork in western Montana is forecast at about 85 percent of average. Streamflow will be substantially less in the upper reaches of the main river on down the Bitterroot. On this latter stream some late season water shortages are likely to occur.

The Spokane and Snake River tributaries in northern Idaho are forecast to flow about 80 percent of average. Major irrigated areas along the Snake and its major tributaries through southern Idaho will be adequate with no serious depletion of storage. Southern tributaries to the Snake River all have streamflow forecasts far below average for 1966. On streams with storage, this carryover water can make up most of the deficiency, but efforts will be necessary to conserve available water.

The outlook for 1966 water supplies is good in western Oregon but poor in scattered areas of eastern and southeastern sections of the state. Carryover water supplies will be the principal source of water for the larger irrigation project areas on Snake River tributaries. Water stored in reservoirs used mostly for irrigation is 114 percent of average but slightly less than was stored on this date in 1965.

Forecasts of streamflow are slightly below average on both sides of the Cascades and for the Rogue and Klamath.

In contrast to other western areas, snowfall in Washington was slightly greater than average during March. Water supplies for both irrigation and power should be adequate for the 1966 season. The flow of the Columbia through the state will be near average and a little less than average below its junction with the Snake River. Reservoirs on the Chelan and Yakima rivers have below average water in storage but these will fill during the snowmelt runoff.

Winter flows have been below average, which is partially responsible for reservoir depletion.

## ALASKA

Little additional snow fell throughout interior Alaska during the month of March. Most of this portion of the state has less than normal snow cover, but the Chena and Upper Tanana Watersheds continue to have considerably more than average. The greater snow cover in this region is the result of heavy snow fall early in the winter.

Southeast Alaska received heavy snow in the mountains during March and the existing snow pack is considerably greater than last year at this time.

## CALIFORNIA

The California Department of Water Resources, coordinating agency for snow surveys in California, reports that the below normal precipitation over most of the state during March has resulted in a substantial reduction in runoff forecasts reported one month ago. This is especially true in the Central Valley where only in the northernmost reaches is streamflow forecasted to be near or above normal. Seasonal precipitation to date in the water stored as snow was well below average in most areas thus qualifying this as a dry year; however, no critical water shortages are anticipated although some deficiencies can be expected in localized areas which are without sufficient conservation facilities to meet late season irrigation demands.

Once again the vagaries of weather were aptly demonstrated in California during this water year. The record and near record precipitation amounts over the state during November and December were offset by the near drought conditions that have prevailed since the first week of January. As of April 1 the seasonal precipitation to date is about 85 percent of normal. Precipitation to date in southern California is 40 percent above normal for this date which reflects earlier seasonal rainfall. Precipitation to date for the Sierra drainages varies between 70 and 75 percent of normal in the Sacramento Valley, between 80 and 85 percent of normal in the San Joaquin Valley, except for the Kaweah and Tule river basins which are 65 percent of normal.

During March the North Coastal and Colorado desert areas were the only areas of the state to receive over 50 percent of normal precipitation. Precipitation for the entire state was only 40 percent of average for the month. In the mountain drainages of the Central Valley excluding the upper Sacramento basin with 70 percent of normal precipitation for the month varied from a low of 10 percent of normal in the Tule and Kaweah river basins to a high of 45 percent of normal in the Feather river basin.

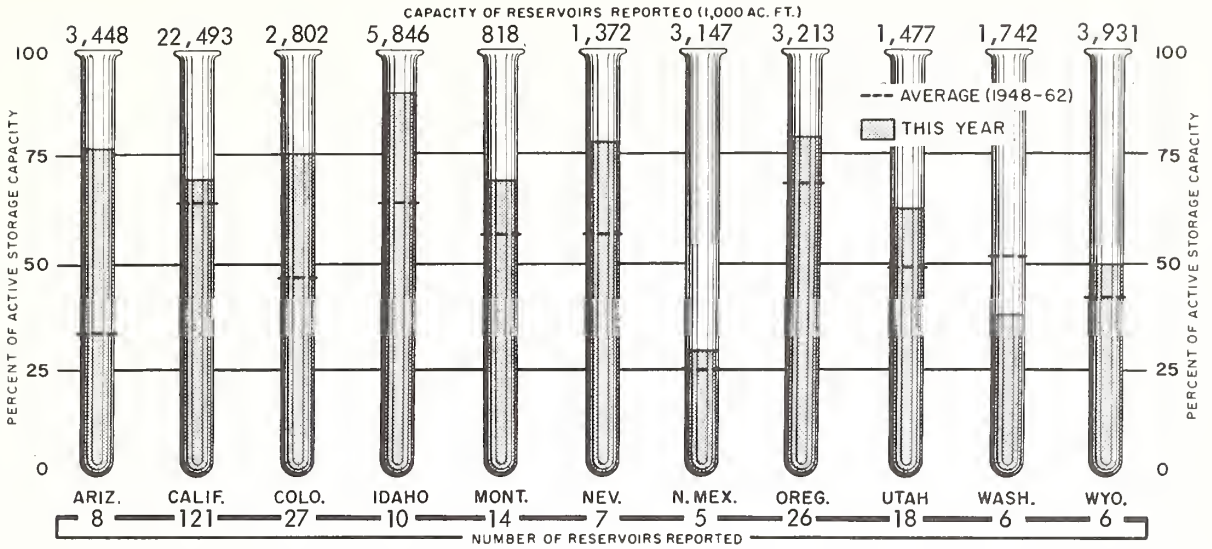
## STORAGE IN LARGE RESERVOIRS APRIL 1, 1966

| BASIN AND NAME OF RESERVOIR | CAPACITY (1000 A.F.) | STORAGE (1000 A.F.) |
|---|---|---|
| UPPER MISSOURI | | |
| Boysen | 700 | 325 |
| Buffalo Bill | 373 | 262 |
| Canyon Ferry | 2043 | 1506 |
| Hebgen | 377 | 222 |
| Tiber | 1316 | 725 |
| Yellowtail | 1409 | 308 |
| Belle Fourche | 185 | 156 |
| Keyhole | 331 | 130 |
| Fort Peck | 19410 | 16830 |
| Fort Randall | 4700 | 3129 |
| Garrison | 19400 | 12924 |
| Oahe | 18100 | 10998 |
| PLATTE | | |
| Glendo | 786 | 423 |
| Pathfinder | 1015 | 486 |
| Seminoe | 1011 | 394 |
| City of Denver | 588 | 471 |
| Colo-Big Thompson (4) | 865 | 500 |
| ARKANSAS | | |
| Conchas | 280 | 258 |
| John Martin | 367 | 374 |
| RIO GRANDE | | |
| Elephant Butte | 2207 | 496 |
| El Vado | 367 | 3 |
| UPPER COLORADO | | |
| Flaming Gorge | 3789 | 2414 |
| Navajo | 1709 | 261 |
| Powell | 28040 | 8907 |
| Blue Mesa | 941 | 169 |
| LOWER COLORADO | | |
| Havusu | 619 | 557 |
| Mead | 27209 | 15502 |
| Mohave | 1709 | 1734 |
| San Carlos | 1206 | 496 |
| Salt River Res. (4) | 1755 | 1682 |
| Verde River Res. (2) | 323 | 311 |
| GREAT BASIN | | |
| Bear | 1421 | 1131 |
| Lahontan | 286 | 217 |
| Rye Patch | 179 | 179 |
| Sevier Bridge | 236 | 130 |
| Strawberry | 270 | 121 |
| Tahoe | 732 | 535 |
| Utah | 1149 | 783 |

| BASIN AND NAME OF RESERVOIR | CAPACITY (1000 A.F.) | STORAGE (1000 A.F.) |
|---|---|---|
| UPPER COLUMBIA | | |
| Chelan | 676 | 85 |
| Coeur d'Alene | 238 | 187 |
| Flathead | 1791 | 650 |
| Hungry Horse | 2982 | 2214 |
| Kootenay | 673 | 182 |
| Pend Oreille | 1155 | 966 |
| Roosevelt | 5232 | 872 |
| LOWER COLUMBIA | | |
| Cougar | 155 | 63 |
| Detroit | 300 | 154 |
| Hills Creek | 200 | 100 |
| Lookout Point | 337 | 110 |
| Yakima Res. (5) | 1066 | 579 |
| SNAKE | | |
| American Falls | 1700 | 1428 |
| Arrowrock | 287 | 283 |
| Anderson Ranch | 423 | 350 |
| Brownlee | 980 | 390 |
| Cascade | 653 | 493 |
| Jackson | 847 | 696 |
| Lucky Peak | 278 | 284 |
| Palisades | 1202 | 1037 |
| Owyhee | 715 | 648 |
| PACIFIC COASTAL | | |
| Cachuma | 205 | 192 |
| Casitas | 254 | 86 |
| Clair Engle | 2500 | 2226 |
| Clear Lake | 440 | 241 |
| Nacimiento | 350 | 211 |
| Ross | 1203 | 503 |
| Upper Klamath | 584 | 460 |
| CALIFORNIA CENTRAL VALLEY | | |
| Almanor | 1036 | 654 |
| Berryessa | 1602 | 1610 |
| Camanche | 432 | 119 |
| Don Pedro | 290 | 158 |
| Folson | 1010 | 648 |
| Hetch-Hetchy | 360 | 163 |
| Isabella | 570 | 155 |
| McClure | 281 | 225 |
| Millerton | 521 | 336 |
| Pine Flat | 1013 | 528 |
| Shasta | 4500 | 4090 |

*Reservoir Storage Data Provided by Bureau of Reclamation, Corps of Engineers, Geological Survey, and water using organizations. Data from California and British Columbia provided by Department of Water Resources and Department of Lands, Forests and Water Resources, respectively.*

# RESERVOIR STORAGE as of APRIL 1, 1966




April 1 snowpack measurements indicate that only in the Cascades of the North Coastal area in the upper Sacramento Valley basin was there any accumulation of water content during March. In these areas the April 1 snowpack was about 120 percent of normal -- the only region of the state where above normal conditions were observed. Snowpack water content in the Central Valley drainage ranged from a high of 96 percent of normal in the Feather river basin to a low of 60 percent of normal in the Kern river basin. Snowpack for the entire state was 85 percent of the April 1 average.

Despite the below normal precipitation during March, streamflow was relatively high and generally above one month ago in those areas where the snowpack is the main contributor to the spring runoff. This relatively high runoff was primarily due to unseasonable early snowmelt from all but the highest elevations. Runoff from streams tributary to the Central Valley averaged about 90 percent of normal for the month. In the San Joaquin valley the March runoff for the individual river basins varied almost directly with their snowmelt ranging from a high of 93 percent of normal from the San Joaquin river basin to a low of 32 percent of normal to the Tule river basin. In the Sacramento valley runoff from the Sacramento river basin was 117 percent of normal for the month while for the remaining drainages runoff ranged between 66 and 78 percent of normal.

Based on the April 1 storage for 122 reservoirs which have a combined useful capacity of over 23,000,000 acre feet the aggregate storage in California reservoirs is 110 percent of normal for this season. This represents a net increase of 630,000 acre feet of water in storage over last year at this time.

U.S. DEPARTMENT of AGRICULTURE
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CONSERVATION OF WATER BEGINS WITH THE SNOW SURVEY

# EXPLANATION of STREAMFLOW FORECASTS

All flows are observed flows except as adjusted for: 1/ Change in storage in Hebgen Lake. 2/ Change in storage in Canyon Ferry and Tiber reservoirs. 3/ Change in storage in Gibson Reservoir and measured diversions. 4/ Change in storage in Two Medicine, Four Horns and Lake Francis reservoirs. 5/ Change in storage in Boysen and Buffalo Bill reservoirs.

6/ Change in storage in Boysen, Buffalo Bill, Canyon Ferry, Tiber, and Fort Peck reservoirs. 7/ Plus diversions to Cache la Poudre. 8/ Minus diversions from North Platte, Laramie, and Colorado rivers plus measured diversions above station. 9/ Change in storage in Twin Lakes and Sugar Loaf reservoirs minus diversions from Colorado River.

10/ Change in storage in Rio Grande, Santa Maria, and Continental reservoirs. 11/ Change in storage in Platoro Reservoir. 12/ Change in storage in El Vado Reservoir. 13/ Change in storage in Granby Reservoir plus diversions to Cache la Poudre and through Adams Tunnel. 14/ Changes as indicated in (13) plus Moffatt Tunnel diversion. 15/ Plus diversions to Arkansas River.

16/ Change in storage in Flaming Gorge and Big Sandy reservoirs. 17/ Plus diversion through Duchesne Tunnel. 18/ Change in storage in Scofield Reservoir. 19/ Change in storage in Navajo Reservoir. 20/ (Lee's Ferry) Change in storage in Flaming Gorge, Navajo, Lake Powell, and Big Sandy reservoirs.

21/ Plus Utah Power and Light Company tailrace and Logan, Hyde Park, and Smithfield canals. 22/ (Inflow record computed by U. S. Bureau of Reclamation.) 23/ Plus diversion by Weber-Provo Canal and change in storage in Wanship Reservoir. 24/ Change in storage in Deer Creek Reservoir, minus diversions through Duchesne Tunnel and Weber-Provo Canal, plus diversion through Salt Lake City Aqueduct. 25/ Change of storage in Lake Tahoe and Boca Reservoir. (Forecast by Truckee Basin Committee)

26/ Change in storage in any of these reservoirs above the station: Kootenai Lake, Hungry Horse, Flathead Lake, Pend Oreille Lake, F. D. Roosevelt Lake, Lake Chelan, Coeur d'Alene Lake, Brownlee and Noxon; and pumpage at Roosevelt Lake. 27/ Changes in storage in Coeur d'Alene Lake and diversions by Spokane Valley Farms Company and Rathdrum Prairie canals. 28/ Change in storage in Lake Chelan. 29/ Changes in storage for Jackson Lake and Palisades Reservoir above stations. 30/ Change in storage in Henry's Lake, Island Park and Grassy Lake reservoirs and diversions between Ashton and Rexburg.

31/ Change in storage in Mackay Reservoir, and diversion in Sharp Ditch. 32/ (Combined flow Big Wood River nr. Bellevue and Camas Creek nr. Blaine.) 33/ Change in storage in Arrowrock, Anderson Ranch, and Lucky Peak. 34/ Change in storage in Cascade and Deadwood reservoirs. 35/ Change in storage in Keechelus, Kachess, and Cle Elum reservoirs plus diversion by Kittitas Canal. 36/ (Corrected to natural flow). 37/ Change in storage in Merwin, Yale, and Swift reservoirs. 38/ (Corrected for upstream impairments).

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